

### Days of Our Lives

The amount of daylight in a given day varies from one day to the next. As the seasons change, so does the amount of daylight. In the Northern Hemisphere, the change is greatest the further north you live. In the summer, it is light until late in the evening, allowing plenty of time for leisure activities. In the winter, however, we sometimes arrive at school while it is still dark outside. You probably have noticed the times for sunrise and sunset either in the newspaper or on the television weather report. You probably never realized that the graph of amount of daylight in a year follows a function that is near and dear to our hearts.

The times for sunrise and sunset in 1999 for Philadelphia are given in the following table. Our objective is to find a graph of the function where the day of the year is the input and the number of MINUTES of daylight is the output.

| Day | January |      | February |      | March |      | April |      | May  |      | June |      |
|-----|---------|------|----------|------|-------|------|-------|------|------|------|------|------|
|     | Rise    | Set  | Rise     | Set  | Rise  | Set  | Rise  | Set  | Rise | Set  | Rise | Set  |
|     | h m     | h m  | h m      | h m  | h m   | h m  | h m   | h m  | h m  | h m  | h m  | h m  |
| 01  | 723     | 1646 | 709      | 1720 | 634   | 1752 | 545   | 1825 | 501  | 1855 | 434  | 1923 |
| 02  | 723     | 1647 | 708      | 1721 | 633   | 1753 | 543   | 1826 | 500  | 1856 | 434  | 1924 |
| 03  | 723     | 1648 | 707      | 1722 | 631   | 1755 | 542   | 1827 | 458  | 1857 | 433  | 1925 |
| 04  | 723     | 1649 | 706      | 1723 | 630   | 1756 | 540   | 1828 | 457  | 1858 | 433  | 1925 |
| 05  | 723     | 1650 | 705      | 1724 | 628   | 1757 | 538   | 1829 | 456  | 1859 | 433  | 1926 |
| 06  | 723     | 1651 | 704      | 1726 | 627   | 1758 | 537   | 1830 | 455  | 1900 | 432  | 1927 |
| 07  | 723     | 1652 | 703      | 1727 | 625   | 1759 | 535   | 1831 | 454  | 1901 | 432  | 1927 |
| 08  | 722     | 1652 | 702      | 1728 | 623   | 1800 | 534   | 1832 | 453  | 1902 | 432  | 1928 |
| 09  | 722     | 1653 | 701      | 1729 | 622   | 1801 | 532   | 1833 | 452  | 1903 | 432  | 1928 |
| 10  | 722     | 1654 | 700      | 1730 | 620   | 1802 | 531   | 1834 | 450  | 1904 | 431  | 1929 |
| 11  | 722     | 1656 | 659      | 1732 | 619   | 1803 | 529   | 1835 | 449  | 1905 | 431  | 1929 |
| 12  | 722     | 1657 | 657      | 1733 | 617   | 1804 | 528   | 1836 | 448  | 1906 | 431  | 1930 |
| 13  | 721     | 1658 | 656      | 1734 | 616   | 1805 | 526   | 1837 | 447  | 1907 | 431  | 1930 |
| 14  | 721     | 1659 | 655      | 1735 | 614   | 1806 | 525   | 1838 | 446  | 1908 | 431  | 1931 |
| 15  | 721     | 1700 | 654      | 1736 | 612   | 1807 | 523   | 1839 | 446  | 1909 | 431  | 1931 |
| 16  | 720     | 1701 | 652      | 1738 | 611   | 1808 | 522   | 1840 | 445  | 1910 | 431  | 1931 |
| 17  | 720     | 1702 | 651      | 1739 | 609   | 1809 | 520   | 1841 | 444  | 1911 | 431  | 1932 |
| 18  | 719     | 1703 | 650      | 1740 | 608   | 1810 | 519   | 1842 | 443  | 1912 | 431  | 1932 |
| 19  | 719     | 1704 | 648      | 1741 | 606   | 1811 | 517   | 1843 | 442  | 1913 | 432  | 1932 |
| 20  | 718     | 1705 | 647      | 1742 | 604   | 1813 | 516   | 1844 | 441  | 1913 | 432  | 1933 |
| 21  | 718     | 1707 | 646      | 1743 | 603   | 1814 | 514   | 1845 | 440  | 1914 | 432  | 1933 |
| 22  | 717     | 1708 | 644      | 1744 | 601   | 1815 | 513   | 1846 | 440  | 1915 | 432  | 1933 |
| 23  | 716     | 1709 | 643      | 1746 | 559   | 1816 | 511   | 1847 | 439  | 1916 | 432  | 1933 |
| 24  | 716     | 1710 | 641      | 1747 | 558   | 1817 | 510   | 1848 | 438  | 1917 | 433  | 1933 |
| 25  | 715     | 1711 | 640      | 1748 | 556   | 1818 | 509   | 1849 | 438  | 1918 | 433  | 1933 |
| 26  | 714     | 1712 | 639      | 1749 | 555   | 1819 | 507   | 1850 | 437  | 1919 | 433  | 1933 |
| 27  | 714     | 1714 | 637      | 1750 | 553   | 1820 | 506   | 1851 | 436  | 1919 | 434  | 1934 |
| 28  | 713     | 1715 | 636      | 1751 | 551   | 1821 | 505   | 1852 | 436  | 1920 | 434  | 1934 |
| 29  | 712     | 1716 |          |      | 550   | 1822 | 503   | 1853 | 435  | 1921 | 435  | 1933 |
| 30  | 711     | 1717 |          |      | 548   | 1823 | 502   | 1854 | 435  | 1922 | 435  | 1933 |
| 31  | 710     | 1718 |          |      | 546   | 1824 |       |      | 434  | 1923 |      |      |

| Day | July |      | August |      | September |      | October |      | November |      | December |      |
|-----|------|------|--------|------|-----------|------|---------|------|----------|------|----------|------|
|     | Rise | Set  | Rise   | Set  | Rise      | Set  | Rise    | Set  | Rise     | Set  | Rise     | Set  |
|     | h m  | h m  | h m    | h m  | h m       | h m  | h m     | h m  | h m      | h m  | h m      | h m  |
| 01  | 435  | 1933 | 459    | 1914 | 528       | 1832 | 557     | 1743 | 630      | 1658 | 703      | 1636 |
| 02  | 436  | 1933 | 500    | 1913 | 529       | 1831 | 558     | 1742 | 631      | 1657 | 704      | 1636 |
| 03  | 436  | 1933 | 501    | 1912 | 530       | 1829 | 559     | 1740 | 632      | 1656 | 705      | 1636 |
| 04  | 437  | 1933 | 502    | 1911 | 531       | 1827 | 600     | 1738 | 633      | 1655 | 706      | 1635 |
| 05  | 438  | 1933 | 503    | 1910 | 532       | 1826 | 601     | 1737 | 634      | 1654 | 707      | 1635 |
| 06  | 438  | 1932 | 504    | 1909 | 533       | 1824 | 602     | 1735 | 635      | 1653 | 708      | 1635 |
| 07  | 439  | 1932 | 504    | 1908 | 534       | 1823 | 603     | 1734 | 636      | 1652 | 709      | 1635 |
| 08  | 439  | 1932 | 505    | 1906 | 535       | 1821 | 604     | 1732 | 638      | 1651 | 710      | 1635 |
| 09  | 440  | 1931 | 506    | 1905 | 536       | 1819 | 605     | 1730 | 639      | 1650 | 711      | 1635 |
| 10  | 441  | 1931 | 507    | 1904 | 537       | 1818 | 606     | 1729 | 640      | 1649 | 711      | 1635 |
| 11  | 441  | 1930 | 508    | 1903 | 538       | 1816 | 607     | 1727 | 641      | 1648 | 712      | 1635 |
| 12  | 442  | 1930 | 509    | 1901 | 539       | 1814 | 608     | 1726 | 642      | 1647 | 713      | 1636 |
| 13  | 443  | 1930 | 510    | 1900 | 540       | 1813 | 609     | 1724 | 643      | 1646 | 714      | 1636 |
| 14  | 444  | 1929 | 511    | 1859 | 540       | 1811 | 610     | 1723 | 644      | 1645 | 714      | 1636 |
| 15  | 444  | 1928 | 512    | 1857 | 541       | 1809 | 611     | 1721 | 646      | 1644 | 715      | 1636 |
| 16  | 445  | 1928 | 513    | 1856 | 542       | 1808 | 612     | 1720 | 647      | 1644 | 716      | 1637 |
| 17  | 446  | 1927 | 514    | 1855 | 543       | 1806 | 613     | 1718 | 648      | 1643 | 717      | 1637 |
| 18  | 447  | 1927 | 515    | 1853 | 544       | 1805 | 614     | 1717 | 649      | 1642 | 717      | 1637 |
| 19  | 447  | 1926 | 516    | 1852 | 545       | 1803 | 615     | 1715 | 650      | 1641 | 718      | 1638 |
| 20  | 448  | 1925 | 517    | 1850 | 546       | 1801 | 616     | 1714 | 651      | 1641 | 718      | 1638 |
| 21  | 449  | 1924 | 518    | 1849 | 547       | 1800 | 617     | 1713 | 652      | 1640 | 719      | 1639 |
| 22  | 450  | 1924 | 519    | 1848 | 548       | 1758 | 618     | 1711 | 654      | 1640 | 719      | 1639 |
| 23  | 451  | 1923 | 520    | 1846 | 549       | 1756 | 620     | 1710 | 655      | 1639 | 720      | 1640 |
| 24  | 452  | 1922 | 521    | 1845 | 550       | 1755 | 621     | 1708 | 656      | 1639 | 720      | 1640 |
| 25  | 453  | 1921 | 522    | 1843 | 551       | 1753 | 622     | 1707 | 657      | 1638 | 721      | 1641 |
| 26  | 453  | 1920 | 523    | 1842 | 552       | 1751 | 623     | 1706 | 658      | 1638 | 721      | 1641 |
| 27  | 454  | 1919 | 524    | 1840 | 553       | 1750 | 624     | 1705 | 659      | 1637 | 721      | 1642 |
| 28  | 455  | 1918 | 524    | 1839 | 554       | 1748 | 625     | 1703 | 700      | 1637 | 722      | 1643 |
| 29  | 456  | 1917 | 525    | 1837 | 555       | 1746 | 626     | 1702 | 701      | 1637 | 722      | 1644 |
| 30  | 457  | 1916 | 526    | 1835 | 556       | 1745 | 627     | 1701 | 702      | 1636 | 722      | 1644 |
| 31  | 458  | 1915 | 527    | 1834 |           |      | 628     | 1700 |          |      | 722      | 1645 |

Complete the table giving the total amount of sunlight per day.

| Day | Hrs. | Min | Total<br>minutes | Day | Hrs. | Min | Total<br>minutes |
|-----|------|-----|------------------|-----|------|-----|------------------|
| 1   | 9    | 5   | 545              | 191 |      |     |                  |
| 11  |      |     |                  | 201 |      |     |                  |
| 21  |      |     |                  | 211 |      |     |                  |
| 31  |      |     |                  | 221 |      |     |                  |
| 41  |      |     |                  | 231 |      |     |                  |
| 51  |      |     |                  | 241 |      |     |                  |
| 61  |      |     |                  | 251 |      |     |                  |
| 71  |      |     |                  | 261 |      |     |                  |
| 81  |      |     |                  | 271 |      |     |                  |
| 91  |      |     |                  | 281 |      |     |                  |
| 101 |      |     |                  | 291 |      |     |                  |
| 111 |      |     |                  | 301 |      |     |                  |
| 121 |      |     |                  | 311 |      |     |                  |
| 131 |      |     |                  | 321 |      |     |                  |
| 141 |      |     |                  | 331 |      |     |                  |
| 151 |      |     |                  | 341 |      |     |                  |
| 161 |      |     |                  | 351 |      |     |                  |
| 171 |      |     |                  | 361 |      |     |                  |
| 181 |      |     |                  |     |      |     |                  |

Graph the points from the above table with the x-axis representing the day of the year (numbered 1-365) and the y-axis representing the number of minutes of daylight. Connect these points with a SMOOTH graph.

The graph should reflect what you know about the seasons.

1. From your graph, what day has the most daylight?
2. What day has the least amount of daylight?
3. Is this what you might have expected? Explain.
4. From examination of the table, when is the amount of daylight changing most rapidly?
5. When is the amount of daylight changing the least?
6. Explain how this corresponds to your knowledge of the seasons.

7. Looking at the graph, is it reasonable to express the data as a sine or cosine function? Explain.
8. What is the amplitude of the function?
9. What is the period of the function? THINK!
10. What is the vertical movement of the function?
11. Write an equation to express this graph. Show all work in an organized fashion. Make sure the work is legible.
12. Pick three days that you did not use in the table and, using the equation you found in #11, calculate the amount of daylight expected. Does your function give a good means of predicting the number of minutes of daylight on a given day? Explain why you may have any discrepancies.